

WHAT IS CLAIMED IS:

Sub A1 1. Refrigerant blends not containing HCFC for use in a very low temperature refrigeration system, said refrigerant blends in mol percent comprising:

Component	Molar Fraction (percent)				Overall range (mole %)
	Blend A	Blend B	Blend C	Blend D	
Argon	13	24	18	8	4 - 36
R-14	34	26	35	24	10 - 55
R-23	28	22	21	32	10 - 50
R-125	11	11	12	11	5 - 20
R-236fa	14	17	14	25	7 - 40

2. Refrigerant blends not containing HCFC's, for use in a very low temperature refrigeration system with low temperature (evaporator) temperature as low as 105K, said refrigerant blends comprising:

	Ingredient Name	Range (% by mol)
1	At least one of neon (Ne) or helium (He)	0.0 - 10.0
2	At least one of argon (Ar) or nitrogen (N2)	10.0 - 45.0
3	R-14 (CF4)	20.0 - 50.0
4	R-23 (CHF3)	10.0 - 30.0
5	R-125 (C2HF5)	8.0 - 15.0
6	R-134a	0.0 - 5.0
7	Other high boiling components: at least one of R-236fa, E-347, R-245fa, R-4112	0.0 - 3.0

3. Refrigerant blends not containing HCFC's, for use in a very low temperature refrigeration system with low temperature (evaporator) as low as 118, said refrigerant blends comprising:

	Ingredient Name	Range (% by mole)
1	At least one of argon (Ar) or nitrogen (N2)	10.0 - 40.0
2	R-14	20.0 - 50.0
3	R-23	10.0 - 40.0
4	R-125	0.0 - 35.0
5	R-134a	0.0 - 10.0
6	At least one of E-347, R-4112, R-236fa, R-245fa.	0.0 - 6.0

temperature (evaporator) as low as 155K, said refrigerant blends comprising:

	Ingredient Name	Range (% by mole)
1	At least one of argon (Ar) or nitrogen (N2)	0.0 - 40.0%
2	R-14	5.0 - 50.0%
3	R-23	5.0 - 40.0%
4	R-125	0.0 - 40.0%
5	R-134a	0.0 - 30.0%
6	At least one of R-236fa or R-245fa	0.0 - 30.0%
7	At least one of E-347 or R-4112	0.0 - 20.0%

2. Refrigerant blends as in claim 1 and further comprising at least one additional component in each said blend, the components maintaining the same proportions relative to each other after addition of said additional component.

9. Refrigerant blends as in claim 2 and further comprising at least one additional component in each said blend, the components maintaining the same proportions relative to each other after addition of said additional component.

16. Refrigerant blends as in claim 3 and further comprising at least one additional component in each said blend, the

components maintaining the same proportions relative to each other after addition of said additional component.

23 10. Refrigerant blends as in claim ²²~~4~~ and further comprising at least one additional component in each said blend, the components maintaining the same proportions relative to each other after addition of said additional component.

20 11. Refrigerant blends as in claim ²⁹~~5~~ and further comprising at least one additional component in each said blend, the components maintaining the same proportions relative to each other after addition of said additional component.

31 12. Refrigerant blends as in claim ³⁶~~6~~ and further comprising at least one additional component in each said blend, the components maintaining the same proportions relative to each other after addition of said additional component.

3 13. Refrigerant blends as in claim 1, wherein said refrigeration system is a compressor cycle in one of an autorefrigerating cascade having a liquid/vapor phase separator, throttle device refrigeration system, and a Klimenko type system.

10 14. Refrigerant blends as in claim ³2, wherein said refrigeration system is a compressor cycle in one of an autorefrigerating cascade having a liquid/vapor phase separator, throttle device refrigeration system, and a Klimenko type system.

17 15. Refrigerant blends as in claim ¹⁵3, wherein said refrigeration system is a compressor cycle in one of an autorefrigerating cascade having a liquid/vapor phase separator, throttle device refrigeration system, and a Klimenko type system.

24 16. Refrigerant blends as in claim ²²4, wherein said refrigeration system is a compressor cycle in one of an autorefrigerating cascade having a liquid/vapor phase separator, throttle device refrigeration system, and a Klimenko type system.

31 17. Refrigerant blends as in claim ²⁹5, wherein said refrigeration system is a compressor cycle in one of an autorefrigerating cascade having a liquid/vapor phase separator, throttle device refrigeration system, and a Klimenko type system.

30 18. Refrigerant blends as in claim ³⁶6, wherein said refrigeration system is a compressor cycle in one of an

autorefrigerating cascade having a liquid/vapor phase separator, throttle device refrigeration system, and a Klimenko type system.

11/19. Refrigerant blends as in claim 1 wherein said refrigerating system alternatively permits flow of cold refrigerant or flow of hot refrigerant to an evaporator.

11/20. Refrigerant blends as in claim ⁸~~2~~ wherein said refrigerating system alternatively permits flow of cold refrigerant or flow of hot refrigerant to an evaporator.

18/21. Refrigerant blends as in claim ¹⁵~~3~~ wherein said refrigerating system alternatively permits flow of cold refrigerant or flow of hot refrigerant to an evaporator.

25/22. Refrigerant blends as in claim ²²~~4~~ wherein said refrigerating system alternatively permits flow of cold refrigerant or flow of hot refrigerant to an evaporator.

32/23. Refrigerant blends as in claim ²⁹~~5~~ wherein said refrigerating system alternatively permits flow of cold refrigerant or flow of hot refrigerant to an evaporator.

39 24. Refrigerant blends as in claim ~~3~~ wherein said refrigerating system alternatively permits flow of cold refrigerant or flow of hot refrigerant to an evaporator.

5 25. Refrigerant blends not containing HCF's as in claim 1, said blends operating as a replacement in a refrigeration system to provide substantially the same thermodynamic performance in said system as provided by earlier blends of components, in said earlier blends HCF's being greater than 0 mol percent.

12 26. Refrigerant blends not containing HCF's as in claim ~~2~~,⁸ said blends operating as a replacement in a refrigeration system to provide substantially the same thermodynamic performance in said system as provided by earlier blends of components, in said earlier blends HCF's being greater than 0 mol percent.

19 27. Refrigerant blends not containing HCF's as in claim ~~1~~,³ said blends operating as a replacement in a refrigeration system to provide substantially the same thermodynamic performance in said system as provided by earlier blends of components, in said earlier blends HCF's being greater than 0 mol percent.

26 28. Refrigerant blends not containing HCF's as in claim 4, ²³
said blends operating as a replacement in a refrigeration system
to provide substantially the same thermodynamic performance in
said system as provided by earlier blends of components, in said
earlier blends HCF's being greater than 0 mol percent.

33 29. Refrigerant blends not containing HCF's as in claim 5, ²⁹
said blends operating as a replacement in a refrigeration system
to provide substantially the same thermodynamic performance in
said system as provided by earlier blends of components, in said
earlier blends HCF's being greater than 0 mol percent.

40 30. Refrigerant blends not containing HCF's as in claim 6, ³⁶
said blends operating as a replacement in a refrigeration system
to provide substantially the same thermodynamic performance in
said system as provided by earlier blends of components, in said
earlier blends HCF's being greater than 0 mol percent.

41 31. Refrigerant blends as in claim 1, wherein said
refrigeration system includes an object being cooled by the
refrigerant, said object being at least one of

- (a) a metal element in a vacuum chamber freezing out and
trapping undesired gasses such as water vapor,

- (b) a heat exchanger removing heat from a secondary fluid stream including at least one of a liquid, gas, condensing gas, and condensing gas mixture,
- (c) a metal element having internal refrigerant flow passages and cooling at least one of a silicon wafer, piece of glass, plastic piece and an aluminum disc with or without a magnetic coating on it, and
- (d) a biological freezer to at least one of freeze and store biological tissues.

32. Refrigerant blends as in claim ⁸~~2~~, wherein said refrigeration system includes an object being cooled by the refrigerant, said object being at least one of

- (a) a metal element in a vacuum chamber freezing out and trapping undesired gasses such as water vapor,
- (b) a heat exchanger removing heat from a secondary fluid stream including at least one of a liquid, gas, condensing gas, and condensing gas mixture,
- (c) a metal element having internal refrigerant flow passages and cooling at least one of a silicon wafer, piece of glass, plastic piece and an aluminum disc with or without a magnetic coating on it, and
- (d) a biological freezer to at least one of freeze and store biological tissues.

20/33. Refrigerant blends as in claim ¹⁵~~37~~, wherein said refrigeration system includes an object being cooled by the refrigerant, said object being at least one of

- (a) a metal element in a vacuum chamber freezing out and trapping undesired gasses such as water vapor,
- (b) a heat exchanger removing heat from a secondary fluid stream including at least one of a liquid, gas, condensing gas, and condensing gas mixture,
- (c) a metal element having internal refrigerant flow passages and cooling at least one of a silicon wafer, piece of glass, plastic piece and an aluminum disc with or without a magnetic coating on it, and
- (d) a biological freezer to at least one of freeze and store biological tissues.

27/34. Refrigerant blends as in claim ²²~~4~~, wherein said refrigeration system includes an object being cooled by the refrigerant, said object being at least one of

- (a) a metal element in a vacuum chamber freezing out and trapping undesired gasses such as water vapor,
- (b) a heat exchanger removing heat from a secondary fluid stream including at least one of a liquid, gas, condensing gas, and condensing gas mixture,
- (c) a metal element having internal refrigerant flow passages and cooling at least one of a silicon wager,

- (e) a heat exchanger removing heat from a secondary fluid stream including at least one of a liquid, gas, condensing gas, and condensing gas mixture,
- (f) a metal element having internal refrigerant flow passages and cooling at least one of a silicon wafer, piece of glass, plastic piece and an aluminum disc with or without a magnetic coating on it, and a biological freezer to at least one of freeze and store biological tissues.

37. Refrigerant blends as in claim 1, and further comprising lubricating oil in a range of approximately 1% to 10% by weight, said oil being one of POE type and PAG type.

38. Refrigerant blends as in claim 2, and further comprising lubricating oil in a range of approximately 1% to 10% by weight, said oil being one of POE type and PAG type.

39. Refrigerant blends as in claim 3, and further comprising lubricating oil in a range of approximately 1% to 10% by weight, said oil being one of POE type and PAG type.

40. Refrigerant blends as in claim 4, and further comprising lubricating oil in a range of approximately 1% to 10% by weight, said oil being one of POE type and PAG type.

